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FIRE TEST OF PRECAST, REINFORCED CONCRETE ROOF SLABS

by

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for the
Bureau of Yards and Docks
Department of the Navy

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FIRE TEST OF PRECAST, REINFORCED CONCRETE ROOF SLABS

Test Report No. TG10218-23:FP3272
Fire Test 325

1. INTRODUCTION

At the request of the Bureau of Yards and Docks, a fire endurance test was conducted on a roof deck consisting of three precast concrete channel slabs of a special design. This test was a part of a development program of the Bureau of Yards and Docks and was intended to provide data for use in future designs, including prestressed concrete slabs.

2. TEST SPECIMENS

The specimen subject to test was made up of three identical panels, each of which was in the form of a channel 17 ft 10 in. long, 4 ft 2½ in. wide, 8 in. deep along each side or flange, and 1¼ in. thick through the web. Transverse ribs were located one at each end, at each quarter point, and at the center, thereby dividing each panel into four equal bays. The 1¼ in. thick web was reinforced at mid-thickness by 2 by 2 in. no. 12 ga welded wire fabric which was carried down each side flange to 3/4 in. from the bottom. Each flange was reinforced with a single 3/4 in. deformed reinforcing bar and each transverse rib with two ¼ in. deformed round bars.

The concrete was mixed in the proportions of 1 part (by weight) cement, 2½ parts clean Potomac River sand, and 2 parts clean White Marsh gravel. The gravel had been passed through a 3/8 in. sieve. The tests of nine cylindrical samples of the concrete indicated strengths from 6100 to 7300 lb/in.^{2} averaging 6800 lb/in.^{2}. The details of the construction are given in figure 1.

3. TEST METHODS

Three panels were placed to span the long dimension of the test furnace. The edges were butted and the joints sealed with grout. The three panels had aged under the temperature and humidity conditions in a ventilated, occupied work room for periods of 90 to 109 days before test. During test, the bottom sides of the panels were directly exposed to

the furnace fires which were controlled to provide average furnace temperatures as close to those specified in the Standard Methods of Tests of Building Construction and Materials, ASTM E119-53 which include: 1000°F at 5 min, 1300°F at 10 min, 1550°F at 30 min, and 1700°F at 1 hr. Temperatures were measured in the furnace chamber, on the panels' reinforcing steel, and on the unexposed surface of the concrete. The panels were subjected to an applied load of 15.3 lb/ft^2.

4. RESULTS

During the fire test, transverse cracks were observed at 7 min in the top surface along the transverse centerlines of the center and East panels and the North quarter point of the center panel; 9 min, moisture on top surface from above cracks; 10 min, diagonal crack across top surface in Southwest corner; 10½ min, full 1¼ in. thickness of concrete spalled explosively from over half of bay South of center of East panel; 15 min, concrete spalled through about 1/3 of area of South bay of East panel, explosively; 27 min, channel webs and possibly transverse ribs sagging between flanges; 30 min, spall 2 to 4 in. long at bottom of West flange of East panel, near center of span; 47 min, transverse ribs sagged ¼ to ½ in.; 1 hr, slight sag in longitudinal flanges, up to 1 in. sag in web; 1 hr 2½ min, gas off, test ended.

The apparatus by which measurements of the deflections of the panels were to have been made was disarranged by the explosive spalling at 10½ min and accurate measurements were not possible thereafter. The fire exposure severity for the full duration was 93.0 percent of standard. The average temperature as measured on the unexposed surface of the panels had risen the limiting 250 degrees F (139 degrees C) above the initial average by about 10 min and the maximum temperature as measured at any one point had risen the limiting 325 degrees F (181 degrees C) above its initial temperature at the same time. The average temperature, as measured on the 3/4 in. reinforcing bars, reached 1000°F at 1 hr and the maximum at any one point reached 1200°F at 50 min. Plots of the various temperatures measured are given in figure 2. The condition of the specimen after test is shown in figures 3 and 4.

The results of this test indicate a fire endurance limit of about 10 min for the particular specimen tested.

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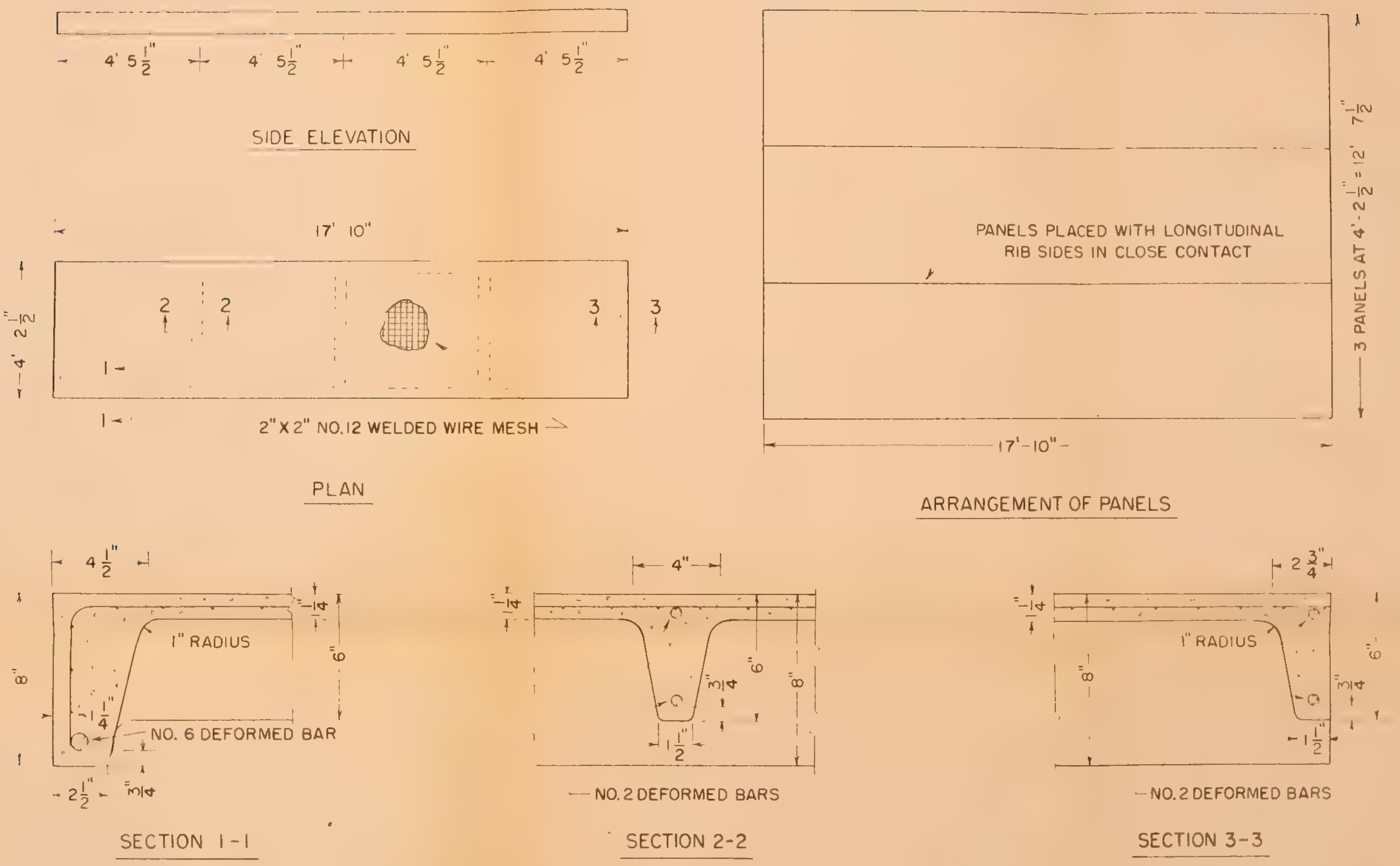


NOTES

CEMENT FACTOR	7 BAGS/CU. YD.	INTERMEDIATE GRADE REINFORCING	24,000 PSI
MAXIMUM SIZE AGGREGATE	$\frac{3}{8}$ IN.	WIRE MESH	30,000 PSI

FIG. I CONSTRUCTION DETAILS OF PRECAST ROOF PANELS

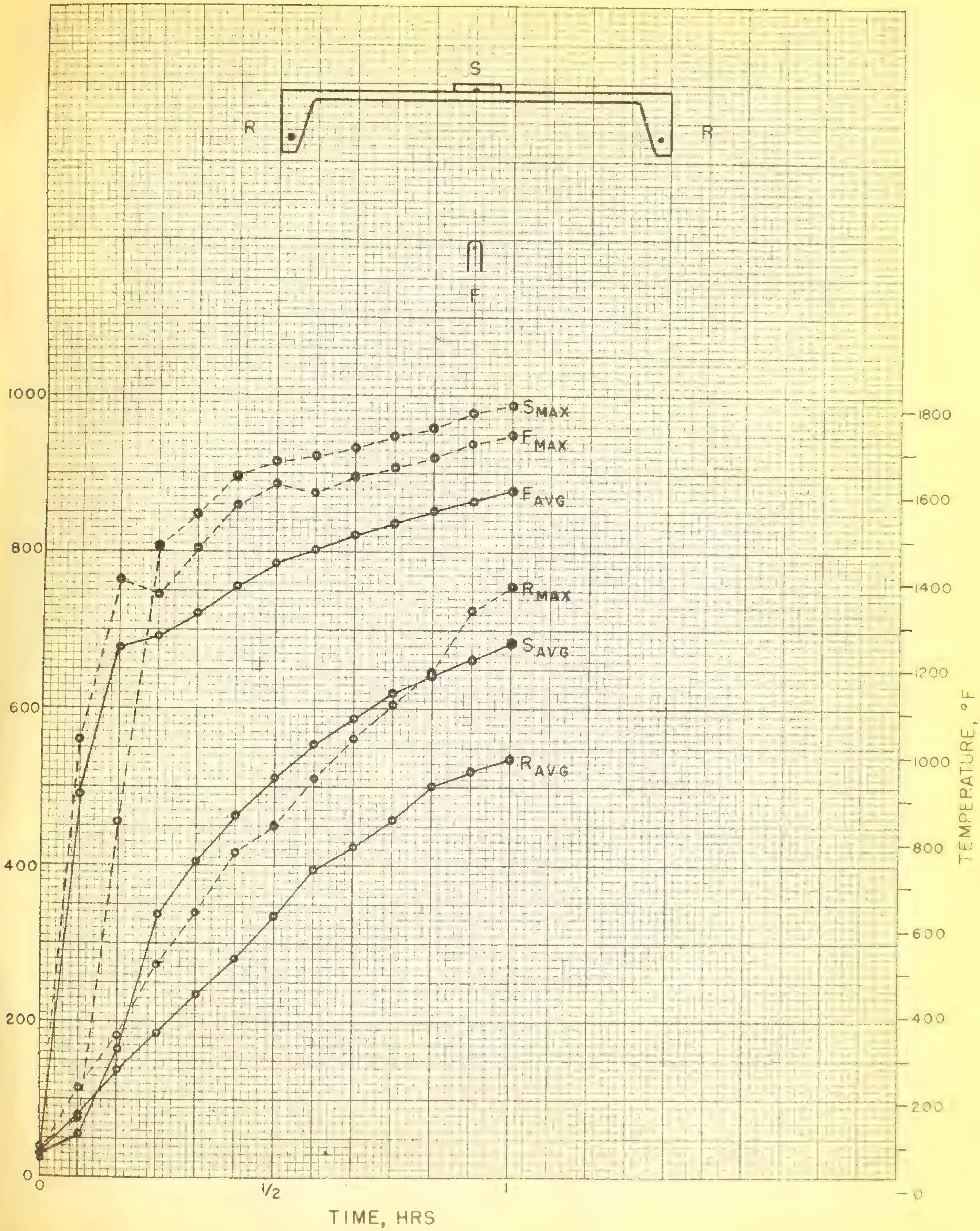
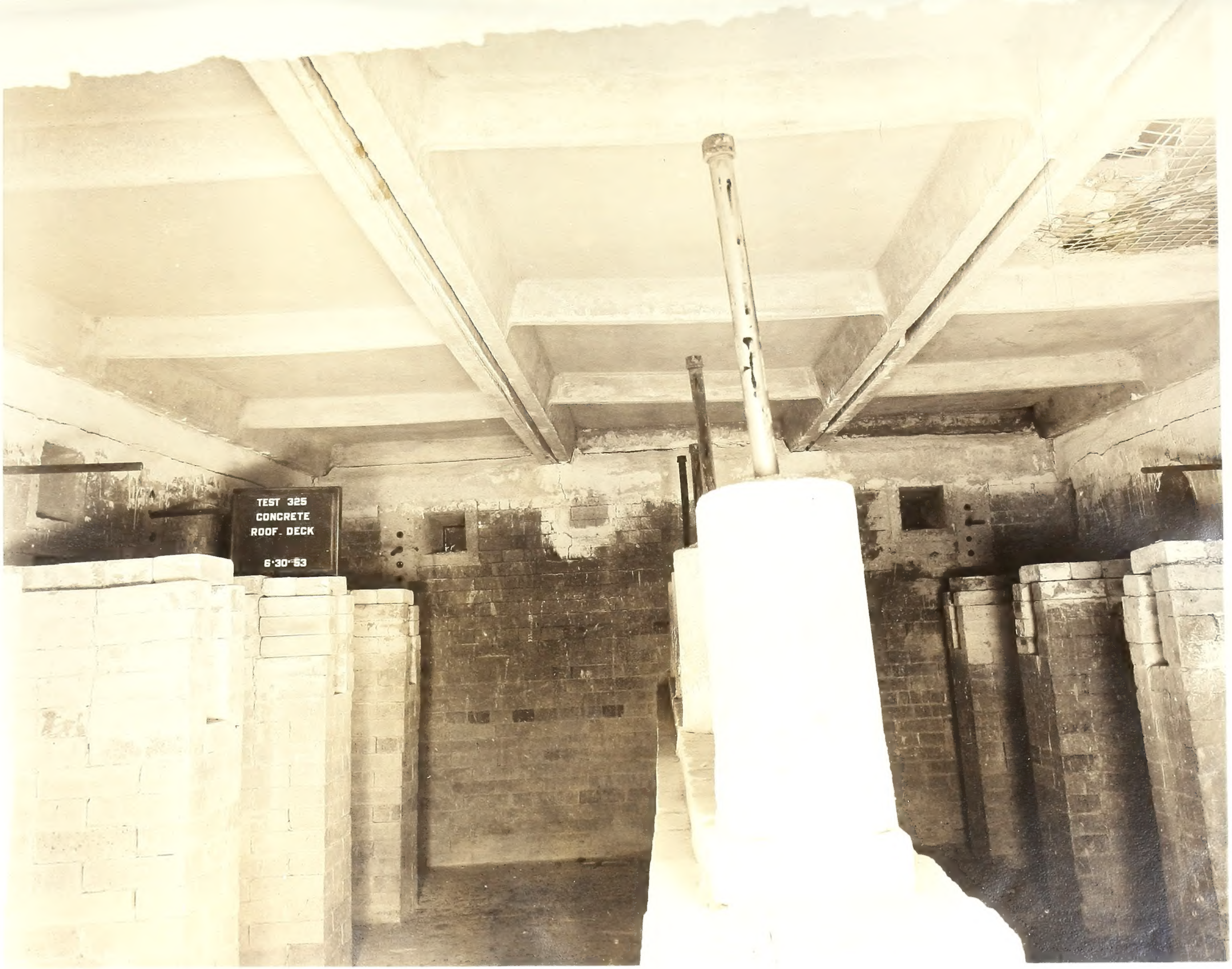


FIG. 2 OBSERVED TEMPERATURES, TEST 325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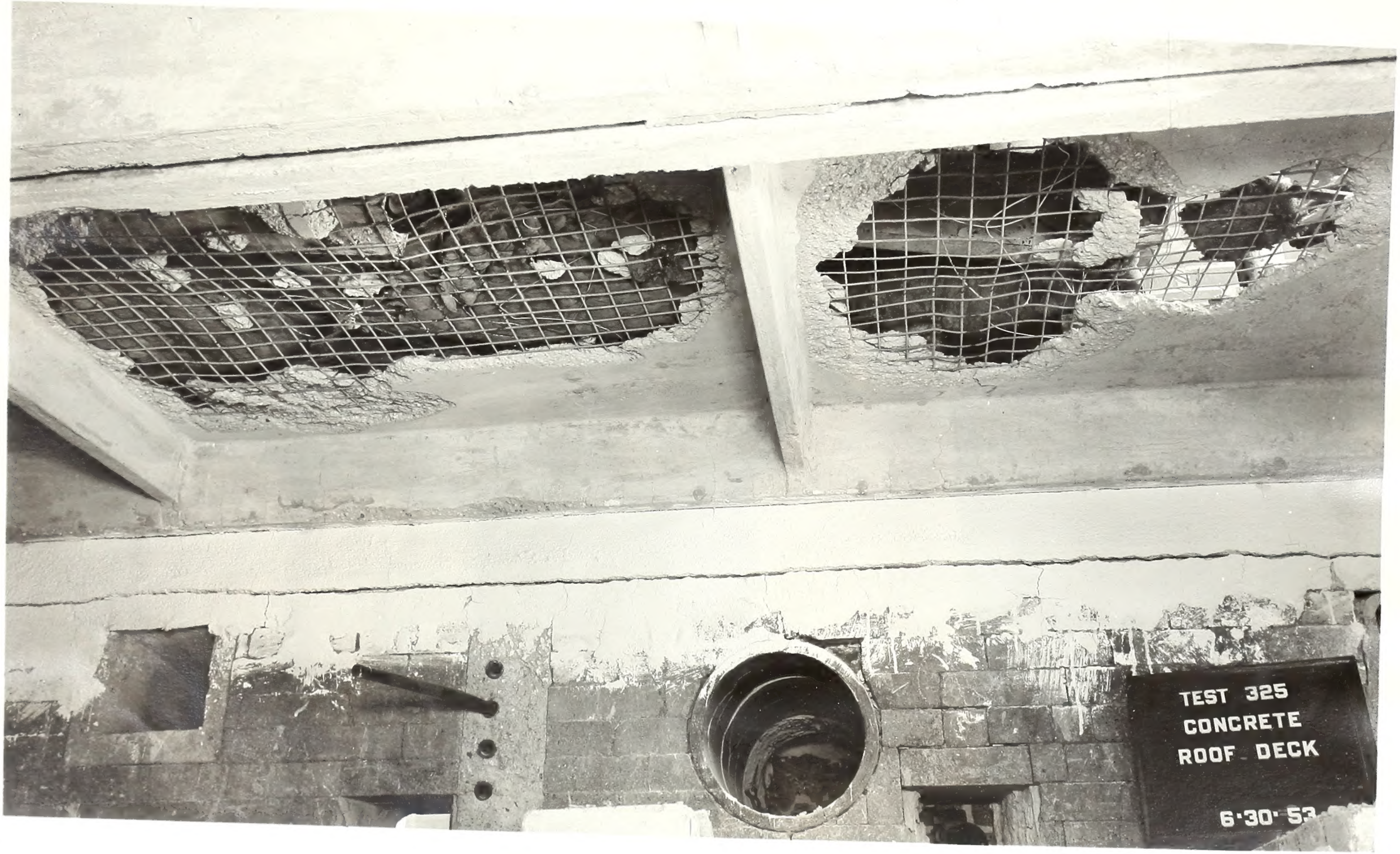
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